AFOSR-TR-95

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# REPORT DOCUMENTATION PAGE



| 1. AGENCY USE ONLY (Leave blank) | 2. REPORT DATE | 3. RE... ...E AND DATES COVERED |
|---|---|---|
| | | FINAL 15 Apr 94 TO 14 Apr 95 |

4. TITLE AND SUBTITLE

SOCIETY FOR RESEARCH ON BIOLOGICAL RHYTHMS AND SYMPOSIUM

5. FUNDING NUMBERS

F49620-94-1-0250

61102F

2312/CS

6. AUTHOR(S)

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7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

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9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

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Bolling AFB DC 20332-8080

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10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT

Approved for public release;
distribution unlimited.

12b. DISTRIBUTION CODE



13. ABSTRACT (Maximum 200 words)

Funds were provided to support the meeting of the Society for Research on Biological Rhythms held from 4-8 May 1994 at Amelia Island, Florida. The meeting was attended by approximately 400 scientists from biological rhythm centers throughout the United States and Canada and from 10 countries abroad. The objectives of the meeting was to promote biological rhythm research through interchange of information in formal settings and informal interaction. An important aspect of the interactions is to promote research directly related to the interests of the Air Force in ameliorating the effects of jet lag and sleep deprivation on performance.



| 14. SUBJECT TERMS | | | 15. NUMBER OF PAGES |
|---|---|---|---|
| | | | 16. PRICE CODE |
| 17. SECURITY CLASSIFICATION OF REPORT (U) | 18. SECURITY CLASSIFICATION OF THIS PAGE (U) | 19. SECURITY CLASSIFICATION OF ABSTRACT (U) | 20. LIMITATION OF ABSTRACT (U) |

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2312-(

# FINAL TECHNICAL REPORT

## AFOSR GRANT F49620-94-1-0250

## SOCIETY FOR RESEARCH ON BIOLOGICAL RHYTHMS




Principal Investigator:

Robert Y. Moore, M.D, Ph.D.
Department of Psychiatry
University of Pittsburgh
3811 O'Hara Street
Pittsburgh, PA 15213


Project Period: 6/1/94 - 5/31/95

Air Force Office of Scientific Research
Bolling Air Force Base, D. C. 20322-6448
Attention: Dr. Genevieve Haddad

TECHNICAL REPORT

Objectives: Funds were provided to support the meeting of the Society for Research on Biological Rhythms held from May 4-8, 1994 at Amelia Island, Florida. The meeting was attended by approximately 400 scientists from biological rhythm centers throughout the United States and Canada and from 10 countries abroad. The objective of the meeting was to promote biological rhythm research through interchange of information in formal settings and informal interaction. An important aspect of the interactions is to promote research directly related to the interests of the Air Force in ameliorating the effects of jet lag and sleep deprivation on performance.

Accomplishments: The Society for Research on Biological Rhythms meeting consisted of ten symposia covering broad areas of biological rhythm research, eight workshops on specialized topics, nine slide sessions and two poster sessions. In total, there were 40 presentations in symposia, 54 presentations in workshops and 208 communications in slide and poster sessions. There was a Presidential Address by Robert Y. Moore, an AFOSR grant recipient.

AFOSR funds were used to support the attendance at the meeting of distinguished scientists who work in biological rhythms but are not members of the Society. These included the following:

Dr. David Ginty
Harvard University
"Molecular Biology of Clock Control"

Dr. Peretz Lavie
Technician - Israel Institute
"Regulation of Human Sleep"

Dr. Mary Carskadon
Brown University
"Determinants of Human Sleepiness"

Dr. Simon Folkard
University of Sheffield
"Circadian Variations in Mood and Performance"

Dr. Ellen Frank
University of Pittsburgh
"Biological Rhythms and Depression"

Dr. Xanjie Yang
Harvard University
"Cell Fate Determination in the Retina"

Dr. William Dement
Stanford University
"REM Sleep Regulation"

Dr. Gabrielle Brandenberger
CNRS, Strasbourg
"Endocrine Concomitants of the REM-nonREM Sleep Cycle"

Dr. Paolo Sasson-Corsi
CNRS, Strasbourg
"Molecular Biology of Clocks"

Dr. Jeppe Sturis
University of Chicago
"Oscillators in the Control of Insulin Secretion"

Dr. James Krueger
University of Tennessee
"Sleep is Important for the Immune System"

Dr. Susan S. Golden
Texas A & M University
"Circadian Regulation of Gene Expression"

A copy of the scientific program is appended as a component of this report.

Publications: None

Inventions, Patents: None

# Program and Abstracts

for the
Fourth Meeting
of the
Society for Research on

# Biological Rhythms

Amelia Island Plantation Conference Center
Jacksonville, Florida
May 4-8, 1994

# PROGRAM SCHEDULE

**WEDNESDAY, MAY 4**

12:00 - 18:00 Registration:
Conference Center Patio

19:30 - 22:00 Opening Reception:
Beach Club Deck/Pool

**THURSDAY, MAY 5**

08:00- 10:00 ***Symposia 1-3***

1. Clock Regulated Gene Expression
   Conference Room A
2. Circadian Control of Alertness and Sleepiness
   Conference Room B/C
3. Mechanisms of Non-Photic Entrainment
   Conference Room 4/5

10:00 - 10:30 Coffee Break
Conference Center Patio

10:30 - 12:30 ***Slide Sessions 1-5***

1. Pacemaker Organization and Function
   Conference Room A
2. Endocrinology and Metabolism
   Conference Room B
3. Jet Lag, Shift Work and Their Treatment
   Conference Room C
4. Photoperiodism and Seasonal Rhythms
   Conference Room 4/5
5. Cellular Mechanisms of Rhythm Regulation: Normal and Abnormal
   Conference Room 2/3

12:30 - 16:30 Break: Put up posters (Group A)
Conference Room 1-3

16:30 - 18:30 ***Workshops 1-4***

1. Light Treatment for Sleep Disorders
   Conference Room A
2. The Aging Circadian System
   Conference Room B
3. The Wonderful World of SCN Glia
   Conference Room C
4. Complex Oscillatory Systems: Molecular Cellular and Mathematical Analysis
   Conference Room 4/5

18:30 - 20:30 Break

20:30 - 22:30 ***Poster Presentations, Group A***
Conference Room 1-3

**FRIDAY, MAY 6**

08:00 - 10:00 ***Symposia 4-6***

4. REM Sleep
   Conference Room A
5. Signal Transduction in the Suprachiasmatic Nucleus
   Conference Room B/C
6. Ultradian Circadian and Seasonal Endocrine Rhythms
   Conference Room 4/5

10:00 - 10:30 Coffee Break
Conference Center Patio

10:30 - 12:30 ***The Society Symposium***
"A Biennium of Progress: 1992 - 1994"
Conference Room A-C

12:30 -16:30 Break

Take down Group A posters by 14:00

Put up Group B posters by 15:00

*NOTICE:* For those interested, a debate on "Patenting Specified Uses of Melatonin and Light: Facts and Evaluation" will be held in Conference Room A from 14:00 - 15:30. Chairs: Nicolas Mrosovsky and Eve Van Cauter.

16:30 - 18:30 ***Presidential Address***
**Robert Y. Moore** "Adventures in the Rhythm Trade"
Introduced by **Fred W. Turek**
Conference Room A-C

18:30 - 19:30 ***Business Meeting***
Conference Room A-C

20:00 - 22:30 ***Banquet***
Beach Club Deck/Pool

SATURDAY, MAY 7

08:00 - 10:00 *Symposia 7-9*

7. Identifying Pacemaker Neurons Within Pacemaker Tissue
   Conference Room A
8. Implication of Circadian Rhythm Abnormalities in Depression
   Conference Room B/C
9. Ontogeny of the Circadian System
   Conference Room 4/5

10:00 - 10:30 Coffee Break
Conference Center Patio

10:30 - 12:30 *Slide Sessions 6-9*

6. Sleep, Sleepiness and Mood
   Conference Room A
7. Entrainment Pathways and Mechanisms
   Conference Room B
8. Molecular Mechanisms
   Conference Room C
9. Melatonin and Rhythm Regulation
   Conference Room 4/5

12:30 -15:30 Break

15:30 - 17:30 *Workshops 5-8*

5. State Variables and Feedback Regulated Genes
   Conference Room A
6. Photoreceptors in Vertebrate Circadian Systems
   Conference Room B
7. Chronobiological Basis for Cancer Therapy
   Conference Room C
8. Type 0 or Type 1 Resetting by Light in Mammals: Are They Really Incompatible?
   Conference Room 4/5

17:30 - 19:30 *Poster Presentations, Group B*
Conference Room 1-3

# SCIENTIFIC PROGRAM

THURSDAY, MAY 5

08:00-10:00 Conference Room A
**Symposium 1**
**Clock Regulated Gene Expression**

Chair: **Jennifer Loros**
Dartmouth University

Speakers: **David D. Ginty**
Harvard University
*CREB, Clocks, and Calcium: Transcriptional Control of c-fos*

**Steve A. Kaye**
University of Virginia
*Molecular Genetic Dissection of the Arabidopsis Circadian Clock*

**Susan S. Golden**
Texas A&M University
*Circadian Regulation of Gene Expression in Cyanobacteria*

08:00-10:00 Conference Room B/C
**Symposium 2**
**Circadian Control of Alertness and Sleepiness**

Chair: **Timothy H. Monk**
University of Pittsburgh

Speakers: **Peretz Lavie**
Technion-Israel Institute
*Sleeping at the Right Time - Validation of the Concept of the Sleep Gate*

**Mary A. Carskadon**
Brown University
*Determinants of Sleepiness as Assessed by Multiple Sleep Latency Test (MSLT)*

**Simon Folkard**
University of Sheffield
*Dissecting Circadian Variations in Mood and Performance*

**David F. Dinges**
University of Pennsylvania
*Alertness During Sleep Deprivation: Circadian and Homeostatic Influences*

08:00-10:00 Conference Room 4/5
**Symposium 3**
**Mechanisms of Non-Photic Entrainment**

Chair: **Dale M. Edgar**
Stanford University

Speakers: **Nicolas Mrosovsky**
University of Toronto
*Behavioral Clock Resetting: Problems and Possibilities*

**Fred W. Turek**
Northwestern University
*Role of Monoamines and Midbrain Nuclei in Non-Photic Entrainment*

**Lawrence P. Morin**
SUNY Stony Brook
*The Circadian Visual System and Non-Photic Entrainment*

10:00-10:30 Coffee Break
Conference Center Patio

10:30-12:30 Conference Room A
**Slide Session 1**
**Pacemaker Organization and Function**
Chair: Lise Martinet

10:30
1 TIME-PLACE ASSOCIATION IN MICE: A CIRCADIAN FUNCTION. S. Daan, W. Leiwakabessy, G. Overkamp, and M.P. Gerkema. Zoological Laboratory, University of Groningen.

10:45
2 MULTIOSCILLATOR CONTROL OF THE CIRCADIAN BODY TEMPERATURE RHYTHM OF JAPANESE QUAIL. Herbert Underwood and Kent Edmonds. Department of Zoology, North Carolina State University.

11:00
3 SEX DIFFERENCES IN THE CIRCADIAN RHYTHMS OF A DIURNAL MAMMAL, *OCTODON DEGUS*. Theresa M. Lee, Susan E. Labyak, and Namni Goel. University of Michigan, Department of Psychology.

11:15

4 LOCATION OF SCN GRAFT INFLUENCES PRECISION OF RECOVERED CIRCADIAN ACTIVITY RHYTHM. J. LeSauter, P. Romero, and R. Silver. Dept. of Psychology, Barnard College of Columbia University.

11:30

5 SINGLE UNIT ACTIVITY RECORDED FROM RODENT SUPRACHIASMATIC NUCLEUS EXPLANTS CULTURED ON MULTI-MICRO-ELECTRODE PLATES. Sat Bir S. Khalsa and Gene D. Block. NSF Center for Biological Timing, University of Virginia.

11:45

6 REGULATION OF *vgf*, A LATE RESPONSE GENE, IN THE SUPRACHIASMATIC NUCLEUS BY LIGHT AND BY THE CIRCADIAN CLOCK. Jonathan P. Wisor[1,2] and Joseph S. Takahashi[1]. [1]NSF Center for Biological Timing, Department of Neurobiology and Physiology, Northwestern University and [2]National Multi-site Training Program in Basic Sleep Research, Interdepartmental Graduate Program in Neuroscience, University of California, Los Angeles.

12:00

7 RESTORATION OF CIRCADIAN RHYTHMS IN AGED HAMSTERS BY TRANSPLANTATION OF THE SUPRACHIASMATIC NUCLEUS. F.C. Davis and N. Viswanathan. Dept. of Biology, Northeastern University.

12:15

8 IS VASOACTIVE INTESTINAL POLYPEPTIDE THE ONLY NEUROPEPTIDE IN THE SUPRACHIASMATIC NUCLEUS OF THE MINK, *MUSTELA VISON?* L. Martinet, C. Bonnefond, and J. Peytevin. Laboratoire de Physiologie Sensorielle, Institut National de la Recherche Agronomique.

10:30-12:30 Conference Room B

**Slide Session 2**

**Endocrinology and Metabolism**

Chair: Barbara L. Parry

10:30

9 INITIAL INVESTIGATIONS INTO BIOLOGICAL TIMING CHARACTERISTICS OF SALTATORY GROWTH DYNAMICS. M. Lampl[1], P. Jeanty[2], and M.L. Johnson[3]. [1]Dept. of Anthropology, University of Pennsylvania, [2]Dept. of Radiology, Vanderbilt University, [3]Dept. of Pharmacology, University of Virginia.

10:45

10 EFFECTS OF AGE ON HUMAN GROWTH HORMONE SECRETION DURING WAKE AND DURING SLEEP. Laurence Plat, Jeff Trabb, Paul Linkowski, Patrick Biston, Mireille L'Hermite-Balériaux, Rachel Leproult, and Eve Van Cauter. Department of Medicine, University of Chicago - and - Center for Biological Rhythms, Université Libre de Bruxelles.

11:00

11 EFFECTS OF DAYLENGTH ON PLASMA LEVELS OF GROWTH HORMONE (GH) IN MALE GOLDEN HAMSTERS. Yi-Rong Ge, Brent Laartz, Susan Losee-Olson, and Fred W. Turek. NSF Center for Biological Timing, Northwestern University.

11:15

12 PLASMA MELATONIN CIRCADIAN RHYTHMS DURING THE MENSTRUAL CYCLE AND AFTER LIGHT THERAPY IN PREMENSTRUAL DYSPHORIC DISORDER AND NORMAL CONTROL SUBJECTS. Barbara L. Parry, Sarah L. Berga, Nasim Mostofi, and Anna Resnick. Department of Psychiatry, University of California, San Diego and Dept. of Obstetrics and Gynecology, University of Pittsburgh.

11:30

13 THE MELATONIN RHYTHM OBSERVED THROUGHOUT A 3-CYCLE RESETTING STIMULUS. Theresa L. Shanahan, Jonathan S. Emens, Richard E. Kronauer, Jeanne F. Duffy, and Charles A. Czeisler. Harvard Medical School and Brigham & Women's Hospital.

11:45

14 HEALTHY 80+ YEAR OLDS HAVE INTACT CIRCADIAN RHYTHMS OF PLASMA MELATONIN. Daniel Buysse, Timothy Monk, David Jarrett, Sarah Berga, Jean Miewald, Karen Lowe, and David Kupfer. Sleep and Chronobiology Center, WPIC, University of Pittsburgh School of Medicine.

12:00

15 NAPPING AS A FUNCTION OF TIME OF DAY: IMMUNE & ENDOCRINE MEASURES. C.G. Jiang, V. Gil, F.A. Lue, R.M. Gorczynski, R. Angus, M. Radomski, and H. Moldofsky. University of Toronto Centre for Sleep and Chronobiology; The Toronto Hospital.

12:15

16 LIGHT-DARK CYCLE MODULATES SLEEP ALTERATIONS INDUCED BY *CANDIDA ALBICANS* INFECTION IN RABBITS. J.M. Krueger and L.A. Toth. Departments of Physiology and Comparative Medicine, University of Tennessee.

10:30-12:30 Conference Room C
**Slide Session 3**
**Jet Lag, Shift Work and Their Treatment**
Chair: Jo Arendt

10:30

17 ADAPTATION OF THE TEMPERATURE RHYTHM TO A 10 HOUR EASTWARD TIME ZONE CHANGE. M.B. Spencer, A.N. Nicholson, P.A. Pascoe, and A.S. Rogers. RAF Institute of Aviation Medicine.

10:45

18 RESYNCHRONIZATION OF CIRCADIAN RHYTHMS AFTER DIFFERENT TYPES OF 9-H ADVANCE SHIFTS. A. Samel, H.M. Wegmann, and M. Vejvoda. DLR- Institute of Aerospace Medicine.

11:00

19 ACUTE EFFECTS OF CAFFEINE ON PHASE OF CORE TEMPERATURE IN SIMULATED JET-LAG. Margaret L. Moline, Steven M. Zendell, Charles P. Pollack, and Daniel R. Wagner. Department of Psychiatry, The New York Hospital - Cornell Medical Center.

11:15

20 LIGHT TREATMENT BENEFITS NASA GROUND SUPPORT SHIFTWORKERS DURING SPACE SHUTTLE MISSIONS. K.T. Stewart, *B.C. Hayes, and C.I. Eastman. Biological Rhythms Research Laboratory, Rush-Presbyterian-St. Luke's Medical Center; *Mission Operations Laboratory, Marshall Space Flight Center.

11:30

21 EFFECTS OF BRIGHT LIGHT EXPOSURE ON SHIFT WORK ADAPTATION IN MIDDLE-AGED SUBJECTS. Scott S. Campbell, Anthony Stroud, and Suzanne Lebowitz. Human Chronobiology Lab, Cornell Medical School.

11:45

22 THREE HOURS OF BRIGHT LIGHT DURING THE NIGHT SHIFT ARE AS GOOD AS SIX HOURS FOR PRODUCING CIRCADIAN ADAPTATION. Charmane I. Eastman. Biological Rhythms Research Lab, Rush-Presbyterian-St. Luke's Medical Center.

12:00

23 DAYTIME SLEEP TENDENCY AFTER BRIGHT LIGHT EXPOSURE IN NORMAL SUBJECTS. Marie Dumont, Julie Carrier, Marc Hébert, and Geneviéve Mathieu. Laboratoire de Chronobiologie, Hôpital Sacré-Coeur & Université de Montréal.

12: 15

24 ROBUST PHASE-RESETTING EFFECTS OF MELATONIN IN HUMANS. Alfred J. Lewy, Robert L. Sack, and Mary L. Blood. Sleep and Mood Disorders Laboratory, Oregon Health Sciences University.

10:30-12:30 Conference Room 4/5
**Slide Session 4**
**Photoperiodism and Seasonal Rhythms**
Chair: Brian K. Follett

10:30

25 GONADAL RESPONSES OF MALE SYRIAN HAMSTERS TO MELATONIN AND/OR A SHORT PHOTOPERIOD ARE INHIBITED BY VENTROMEDIAL HYPOTHALAMIC LESIONS BUT NOT PREOPTIC AREA LESIONS. E.S. Maywood and M.H. Hastings. Department of Anatomy, University of Cambridge.

10:45

26 RATE OF CHANGE IN DAY LENGTH RATHER THAN ABSOLUTE DAY LENGTH DETERMINES PHOTOPERIODIC RESPONSES IN SIBERIAN HAMSTERS. M.R. Gorman and I. Zucker. Department of Psychology, University of California, Berkeley.

11:00

27 JAPANESE QUAIL AND EUROPEAN STARLINGS DISPLAY DIFFERENT ACTIVITY CYCLES UNDER 6L:30D PHOTOPERIODIC REGIMES. V.M. King, T.S. Juss, and B.K. Follett. AFRC Research Group on Photoperiodism and Reproduction, School of Biological Sciences, University of Bristol.

11:15

28 LOCOMOTOR ACTIVITY STIMULATES THE REPRODUCTIVE AXES OF REPRODUCTIVELY PHOTORESPONSIVE MEADOW VOLES. Marie Kerbeshian and F.H. Bronson. Institute of Reproductive Biology, Department of Zoology, University of Texas, Austin.

11:30

29 OPSIN- AND GnRH-EXPRESSION IN BIRDS. [1]C.J. Saldanha and [1,2]R. Silver. [1]The Graduate School of Arts and Sciences and [2]Barnard College of Columbia University.

11:45

30 PHOTOPERIODIC STIMULATION INCREASES FOS-LIKE IMMUNOREACTIVITY WITHIN THE TUBERAL HYPOTHALAMUS OF JAPANESE QUAIL. S.L. Meddle and B.K. Follett. AFRC Group on Photoperiodism & Reproduction, School of Biological Sciences, University of Bristol.

12:00

31 THE EFFECT OF MELATONIN ON THE HEMOLYMPH PROTEINS OF THE WOODROACH *PARCOBLATTA PENNSYLVANICA*. G.T. Wassmer, A. Kang, C. Butt, and T.L. Page. Dept. of Biology, Vanderbilt University.

12:15

32 THYROID HORMONES AND ANNUAL REPRODUCTIVE CYCLES IN WELSH MOUNTAIN AND SOAY RAMS. Brian K. Follett and Tim J. Parkinson. AFRC Group on Photoperiodism & Reproduction, and Department of Clinical Veterinary Science, University of Bristol.

10:30-12:30 Conference Room 2/3

**Slide Session 5**

**Cellular Mechanisms of Rhythm Regulation: Normal and Abnormal**

Chair: J. Woodland Hastings

10:30

33 REGULATION OF CELL DIVISION CYCLES BY CIRCADIAN OSCILLATORS IN EUGLENA: SIGNAL TRANSDUCTION BETWEEN CLOCKS. Leland N. Edmunds, Jr., Richard Park, and Gangaram Mohabir. Division of Biological Sciences, State University of New York, Stony Brook.

10:45

34 PROTEIN PHOSPHATASE ACTIVITY IS ESSENTIAL TO THE CIRCADIAN MECHANISM OF *GONYAULAX POLYEDRA*. J. Comolli, W. Taylor, J. Rehmann, and J.W. Hastings. Department of Cellular and Developmental Biology, Harvard University.

11:00

35 A METHOD FOR MAINTAINING THE FILAMENTOUS FUNGUS, *Neurospora crassa*, AS A SINGLE CELL FOR USE IN LONG TERM BIOCHEMICAL STUDIES OF RHYTHMICITY. Kristin M. Lindgren, Jay C. Dunlap, and Jennifer J. Loros. Department of Biochemistry, Dartmouth Medical School.

11:15

36 PACEMAKER PROPERTIES OF INSECT STEROIDOGENIC TISSUE: INDUCTION OF RHYTHMICITY IN VITRO. C.G.H. Steel and X. Vafopoulou. Department of Biology, York University.

11:30

37 PROPERTIES OF CLOCK-CONTROLLED AND CONSTITUTIVE *N*-ACETYLTRANSFERASES FROM CHICK PINEAL CELLS. Michael S. Wolfe, Nancy Lee, and Martin Zatz. SBP, LCB, National Institute of Mental Health.

11:45

38 TEMPERATURE MODULATES PHASE RESPONSE CURVE AMPLITUDE IN CHICK PINEAL CELLS. R. Keith Barrett and Joseph S. Takahashi. NSF Center for Biological Timing, Department of Neurobiology and Physiology, Northwestern University.

12:00

39 SINGLE-CHANNEL ANALYSIS OF POTASSIUM CURRENTS IN CIRCADIAN PACEMAKER CELLS OF *BULLA*. K. Manivannan, S. Michel, and G.D. Block. NSF Center for Biological Timing, Department of Biology, University of Virginia.

12:15

40 PHARMACODYNAMICS ARE AFFECTED BY BOTH FERTILITY AND CIRCADIAN TIME STRUCTURES. Rostislav Vyzula, Patricia Wood, Denise Peace, Teresa Troha, Gina Mann, and William Hrushesky. Stratton VA Medical Center.

12:30-16:30 Break: Put up posters (Group A)
Conference Room 1-3

16:30-18:30 Conference Room A
**Workshop 1**
**Light Treatment for Sleep Disorders**

Discussion Leader: **Michael Terman**
New York State Psychiatric Institute

Derk-Jan Dijk
Scott S. Campbell
Charmane Eastman
Alfred J. Lewy

16:30-18:30 Conference Room B
**Workshop 2**
**The Aging Circadian System**

Discussion Leader: **Phyllis M. Wise**
University of Kentucky

Evelyn Satinoff
Martin R. Ralph
Dale M. Edgar
Fred W. Turek

16:30-18:30 Conference Room C
**Workshop 3**
**The Wonderful World of SCN Glia**

Discussion Leader: **Jacques Servière**
INRA, Jouy-en Josas

Joseph Miller
David Glass
Lawrence Morin
Antonio Nunez
Rebecca Prosser

16:30-18:30 Conference Room 4/5
**Workshop 4**
**Complex Oscillatory Systems: Molecular Cellular and Mathematical Analysis**

Discussion Leader: **Arnold Eskin**
University of Houston

Jack Byrne
Till Roenneberg
W. Otto Friesen
Carl Johnson
Terry Page
Albert Goldbeter
Hongkui Zeng

18:30-20:30 Break

20:30-22:30 **Poster Presentations, Group A**
Conference Room 1-3

*Mutations and Circadian Function*

41 TRANSGENIC MARKERS IN SCN TRANSPLANTATION STUDIES IN THE MOUSE. Martin R. Ralph, Diego A. Golombeck, Mark W. Hurd, and Alexandra L. Joyner*. Department of Psychology, University of Toronto; *Sam Lunenfeld Research Institute, Mount Sinai Hospital.

42 CONSERVATION OF DAILY LOCOMOTOR ACTIVITY IN THE GOLDEN HAMSTER. Steve Osiel, Diego A. Golombeck, and Martin R. Ralph. Department of Psychology, University of Toronto.

43 EFFECTS OF PERIODIC FEEDING ON CIRCADIAN ACTIVITY IN WILD-TYPE AND TAU MUTANT HAMSTERS. Michael S. Grace, Augustus Vogel, and Michael Menaker. Department of Biology and NSF Center for Biological Timing, University of Virginia.

44 PITUITARY HORMONE PULSATILITY IN SCN-LESIONED TAU MUTANT HAMSTERS. J.M. Darrow, R. Hurt, A. Maghsoudi, M. Menaker, R. Talreja, and M.O. Thorner. Center for Biological Timing, Department of Biology, University of Virginia.

45 COMPARISION OF WILDTYPE AND TAU MUTANT HAMSTER ACTIVITY PROFILES. Kathryn Scarbrough, Terrance Pyles, and Fred W. Turek. NSF Center for Biological Timing, Northwestern University.

46 EFFECTS OF THE TAU MUTATION ON AGE-RELATED CHANGES IN THE RESPONSE OF THE CIRCADIAN CLOCK TO LIGHT. P.C. Zee[1,2], M. Menaker, S. Losee-Olson[2], Y. Ge[1], and F.W. Turek[1,2]. Departments of Neurology[1] and Neurobiology and Physiology[2] and National Science Foundation Center for Biological Timing, Northwestern University.

47 LIGHT-INDUCED FOS-LIKE IMMUNOREACTIVITY IN *TAU* MUTANT HAMSTERS SHOWING TYPE 0 AND TYPE 1 RESETTING. Kazuhiro Shimomura and Michael Menaker. Center for Biological Timing, Department of Biology, University of Virginia.

48 NEUROPEPTIDE-Y AND THE TAU MUTANT HAMSTER. S.M. Biello and N. Mrosovsky. Dept. of Zoology, University of Toronto.

49 GENETIC AND PHENOTYPIC ANALYSIS OF *CLOCK*, A MUTATION IN THE CIRCADIAN SYSTEM OF THE MOUSE. M.H. Vitaterna, D.P. King, A.M. Chang, J.M. Kornhauser, P.L. Lowrey, J.D. McDonald*†, W.F. Dove*, L.H. Pinto, F.W. Turek, and J.S. Takahashi. NSF Center for Biological Timing, Department of Neurobiology and Physiology, Northwestern University and *McArdle Laboratory for Cancer Research, University of Wisconsin. †Present address: Department of Biological Sciences, Wichita State University.

50 GENETIC LINKAGE ANALYSIS OF *CLOCK*, A MOUSE GENE ESSENTIAL FOR CIRCADIAN BEHAVIOR. David P. King, Martha Hotz Vitaterna, Anne-Marie Chang, Phillip L. Lowrey, William F. Dove*, Lawrence H. Pinto, Fred W. Turek, and Joseph S. Takahashi. NSF Center for Biological Timing, Department of Neurobiology and Physiology, Northwestern University and *McArdle Laboratory for Cancer Research and Laboratory of Genetics, University of Wisconsin.

51 MUTAGENESIS SCREEN IDENTIFIES A MOUSE *(187)* WITH ALTERED CIRCADIAN RHYTHMS. Gary E. Pickard[1,2,3], Patricia J. Sollars[1,3], Eugene M. Rinchik[4], Patrick Nolan[1], and Maja Bucan[1]. Departments of Psychiatry[1] and Neuroscience[2], and Center for Sleep and Respiratory Neurobiology[3], University of Pennsylvania; and Biology Division, Oak Ridge National Laboratory[4].

52 CIRCADIAN RHYTHMS OF MICE TRANSGENIC FOR THE HUMAN AMYLOID PRECURSOR PROTEIN (APP). Barbara Tate*, Richard Tovar*, James Vitale, Ree Alessandrini, Benjamin Snyder, and Martin Montoya-Zavala. *Department of Psychiatry and Human Behavior, The Miriam Hospital and Brown University; Exemplar Corporation.

53 DEFINING THE TIME THAT THE CIRCADIAN GATE CONTROLLING ECLOSION IN *DROSOPHILA MELANOGASTER* CLOSES. Jan Qiu and Paul Hardin. Department of Biology and Institute of Biosciences and Technology, Center for Advance Invertebrate Molecular Sciences, Texas A&M University.

54 THE CIRCADIAN SYSTEM OF GENE-TARGETED MICE WITH A NULL MUTATION AT THE C-FOS LOCUS. German I. Honrado[1], Randall S. Johnson[2], Bruce M. Spiegelman[2], Virginia Papaioannou[3], and Martin R. Ralph[1]. [1]Departments of Psychology and Zoology, University of Toronto; [2]Dana-Farber Cancer Institute, Harvard Medical School; [3]Department of Pathology, Tufts University.

55 ENTRAINED AND FREE-RUNNING SLEEP-WAKE CIRCADIAN RHYTHMS IN THE *TAU*-MUTANT HAMSTER. D.M. Edgar, W.F. Seidel, C.M. King, W.C. Dement, and M.R. Ralph*. CSCN, Dept. of Psychiatry and Behavioral Sciences, Stanford University School of Medicine, and *Dept. of Psychology, University of Toronto.

56 GFAP-LIKE IMMUNOREACTIVITY IN THE IGL OF SIGHTED AND CONGENITALLY ANOPHTHALMIC MICE. L.K. Laemle and J.E. Ottenweller. Depts. of Anatomy and Neuroscience, UMDNJ-New Jersey Medical School.

*Molecular Analysis*

57 CIRCADIAN GENE EXPRESSION IN CYANOBACTERIA: BACTERIAL LUCIFERASE AS A REPORTER. Y. Liu§, T. Kondo*, S.S. Golden†, M. Ishiura*, and C.H. Johnson§. §Dept. of Biology, Vanderbilt University; *National Institute for Basic Biology; †Dept. of Biology, Texas A&M University.

58 CIRCADIAN REGULATION OF GENE EXPRESSION IN CYANOBACTERIA. S.S. Golden*, M. Ishiura§, C.H. Johnson‡, T. Kondo§, N. Lebedeva*, Y. Liu‡, and N. Tsinoremas*. *Dept. of Biology, Texas A&M University; §National Institute for Basic Biology; ‡Dept. of Biology, Vanderbilt University.

59 RHYTHMS OF CAB *II*, β-TUBULIN, AND CYTOCHROME C mRNA ABUNDANCE IN *CHLAMYDOMONAS* - ARE THEY TRULY CIRCADIAN, INDEPENDENT OF THE CELL DIVISION CYCLE, AND TRANSCRIPTIONALLY REGULATED? S. Jacobshagen[1], L. Shan[1], K. Kindle[2], and C.H. Johnson[1]. [1]Dept. of Biology, Vanderbilt University; [2]Plant Science Center, Cornell University.

60 GENETIC AND MOLECULAR ANALYSIS OF *NEUROSPORA* CLOCK-CONTROLLED GENE-1 *(ccg-1)*. Jennifer J. Loros, Kristin M. Lindgren, Norman Garceau, and Jay C. Dunlap. Department of Biochemistry, Dartmouth Medical School.

61 THE *frequency* LOCUS ENCODES A COMPONENT, A STATE VARIABLE, IN A CELLULAR CIRCADIAN OSCILLATOR. Jay C. Dunlap, Ben Aronson, Jennifer Loros, and K. Johnson. Department of Biochemistry, Dartmouth Medical School.

62 *THE frequency* LOCUS ENCODES FRQ, A STRUCTURALLY AND FUNCTIONALLY CONSERVED PROTEIN REQUIRED FOR NORMAL OPERATION OF A CELLULAR CIRCADIAN OSCILLATOR. Martha Merrow, Jay C. Dunlap, Ben Aronson, and K. Johnson. Department of Biochemistry, Dartmouth Medical School.

63 COMPARATIVE PHYLOGENETIC ANALYSIS OF THE *FREQUENCY (FRQ)* CLOCK GENE SHOWS REGIONS OF CONSERVATION AND DIVERGENCE. M.T. Lewis, L. Morgan, and J.F. Feldman. University of California, Santa Cruz.

64 CLONING AND TRANSFORMANT ANALYSIS OF THE *PERIOD-2 (PRD-2)* CLOCK GENE OF *NEUROSPORA CRASSA*. L. Morgan, M.T. Lewis, K. Wymore, and J.F. Feldman. Dept. of Biology, University of California, Santa Cruz.

65 EFFECTS OF CHOLINE DEPLETION ON THE CIRCADIAN OSCILLATOR OF *NEUROSPORA CRASSA*. Patricia L. Lakin-Thomas. Dept. of Plant Sciences, University of Cambridge.

66 CIRCADIAN RHYTHM DEFECTS IN *DROSOPHILA* cAMP AND PROTEIN KINASE A MUTANTS. J.D. Levine[1], C. Casey[1], D. Kalderon[2], and F.R. Jackson[1]. [1]Worcester Foundation for Experimental Biology; [2]Columbia University.

67 A CIRCADIANLY REGULATED GENE UNDER THE CONTROL OF THE *PERIOD* LOCUS OF *DROSOPHILA MELANOGASTER* ENCODES A PUTATIVE TRANSCRIPTION FACTOR. F. Rouyer, C. Pikielny, and M. Rosbash. Howard Hughes Medical Institute and Department of Biology, Brandeis University.

68 STUDIES ON MOLECULAR PERIODICITY IN *DROSOPHILA*. Kathryn D. Curtin, Hongkui Zheng, Joan E. Rutila, and Michael Rosbash. Howard Hughes Medical Institute, Department of Biology, Brandeis University.

69 EFFECTS OF MELATONIN ON LIGHT-INDUCED PHASE SHIFTS AND *c-fos* mRNA EXPRESSION IN C3H/HeN MICE. S. Benloucif, M.I. Masana, and M.L. Dubocovich. Dept. of Pharmacology, Northwestern University Medical School.

70 RHYTHMIC TRANSCRIPTS IN THE CIRCADIAN SYSTEM CONTROLLING SPERM RELEASE IN INSECTS. J.M. Giebultowicz, A.K. Raina, and D.A. O'Brochta. USDA, ARS, Insect Neurobiology and Hormone Lab and Center for Agriculture Biotechnology, University of Maryland.

71 INVESTIGATION OF THE EFFECTS OF PHASE-SHIFTING TREATMENTS OF 5-HT AND DRB ON THE REGULATION OF PUTATIVE OSCILLATOR PROTEINS (POPs). C. Koumenis, M. Nunez-Regueiro, Q. Trang, M. Sloan, and A. Eskin. Dept. of Biochem. and Biophys. Sci., Univ. of Houston.

72 MOLECULAR CLONING OF A 5HT7-LIKE RECEPTOR FROM XENOPUS LAEVIS. C.S. Nelson, L.S. Robbins, R.D. Cone, and J.P. Adelman. Vollum Institute for Advanced Biomedical Research.

73 IDENTIFICATION OF A NOVEL TRANSCRIPT WITH A DIURNAL RHYTHM IN CHICK PINEAL CELLS. Kenneth J. Seidenman, R. Keith Barrett, Jose C. Florez, and Joseph S. Takahashi. NSF Center for Biological Timing, Department of Neurobiology and Physiology, Northwestern University.

74 KN-62, AN INHIBITOR OF THE CaM KINASE II, BLOCKS CIRCADIAN RESPONSES TO LIGHT. Anuradha Mathur, Diego A. Golombek, and Martin R. Ralph. Department of Psychology, University of Toronto.

*Non-Photic Zeitgebers*

75 ENTRAINMENT TO MEAL TIME INCREASES ACTIVITY STRESS-ULCERS IN RATS. Friedrich K. Stephan, Imgap Yi, and Marcus E. Bays. Program in Neuroscience, Department of Psychology, Florida State University.

76 CONTROL BY LIGHT OF THE TEMPERATURE RHYTHM IN FOOD RESTRICTED HAMSTERS. K.T. Borer and K. Clover. Department of Movement Science, The University of Michigan.

77 SEX DIFFERENCES AND THE EFFECTS OF SOCIAL CUES ON REENTRAINMENT IN OCTODON DEGUS. Namni Goel and Theresa M. Lee. University of Michigan, Department of Psychology.

78 TWELVE HOUR PHASE SHIFTS IN HAMSTER CIRCADIAN RHYTHMS ELICITED BY VOLUNTARY WHEEL RUNNING. Robert L. Gannon and Michael A. Rea. Biological Rhythms and Integrative Neuroscience, Armstrong Laboratory/CFTO, Brooks AFB.

79 BOTH FORCED AND VOLUNTARY ACTIVITY CAN ENTRAIN FREE-RUNNING RHYTHMS IN THE MOUSE. Elliott Marchant and Ralph Mistlberger. Psychology, Simon Fraser University.

80 CIRCADIAN PERIOD, ENTRAINMENT, AND PHASE-SHIFTING IN HYPERACTIVE (WKHA) AND HYPERTENSIVE (WKHT) INBRED RAT STRAINS. Alan M. Rosenwasser, Mark Pellowski, and Edith D. Hendley. Dept. of Psychology, University of Maine and Dept. of Molec. Physiol. and Biophys., University of Vermont.

81 PHASE SHIFTING EFFECTS OF NONPHOTIC STIMULI AT CT 8. K. Bobrzynska and N. Mrosovsky. Dept. of Zoology, University of Toronto.

82 BICUCULLINE BLOCKS NEUROPEPTIDE Y-INDUCED PHASE ADVANCES WHEN MICROINJECTED INTO THE SUPRACHIASMATIC REGION. K.L. Huhman, T.O. Babagbemi, and H.E. Albers. Lab. of Neuroendocrinol. and Behav., Georgia State University.

83 INTERACTION IN THE NONPHOTIC DOMAIN: EFFECTS OF SEROTONIN AND NEUROPEPTIDE Y ON THE SCN *IN VITRO*. Marija Medanic and Martha U. Gillette. Dept. of Physiology & Biophysics and Cell & Structural Biology, University of Illinois.

84 A SEROTONIN NEUROTOXIN BLOCKS THE PHASE-SHIFTING EFFECTS OF AN ACTIVITY-INDUCING STIMULUS ON THE CIRCADIAN CLOCK IN HAMSTERS. P.D. Penev, F.W. Turek, and P.C. Zee. NSF Center for Biological Timing, Department of Neurobiology and Physiology, Northwestern University.

85 SEROTONIN CELLS IN THE MEDIAN RAPHE MODULATE CIRCADIAN RHYTHMS IN THE HAMSTER. E.L. Meyer and L.P. Morin. Dept. of Psychiatry and Dept. of Neurobiology and Behavior, SUNY at Stony Brook.

86 CIRCADIAN FEEDBACK LOOPS: THE POSSIBLE ROLE OF LOCOMOTOR ACTIVITY IN PATIENTS WITH SEASONAL AFFECTIVE DISORDER (SAD). W.K. Koehler, P. Fey, and B. Pflug. Zentrum der Psychiatrie, J.W. Goethe-Universität.

87 EFFECTS OF PERINATAL TREATMENT WITH SEXUAL STEROIDS ON THE INFRADIAN (CIRCA-QUADRIDIAN) ACTIVITY RHYTHM IN ADULT FEMALE GOLDEN HAMSTERS. P. Fritzsche, R. Weinandy, and R. Gattermann. Institut für Zoologie, Martin-Luther-Universität Halle-Wittenberg.

88 CIRCADIAN TIME AND STRESS RESPONSE OF GOLDEN HAMSTERS AND MONGOLIAN GERBILS TO SOCLAL AND NON-SOCIAL STRESSORS. R. Gattermann, R. Weinandy, and P. Fritzsche. Institut für Zoologie, Martin-Luther Universität Halle-Wittenberg.

89 NPY CONTAINING NORADRENERGIC NEURONS ORIGINATING FROM THE BRAINSTEM IS INVOLVED IN FEEDING-ASSOCIATED CIRCADIAN RHYTHM OF PARAVENTRICULAR NPY BUT NOT IN FASTING-INDUCED INCREASE IN NPY IN RATS. Yumiko Katsuno, Toshihiro Yoshihara, Sato Honma, and Ken-ichi Honma. Department of Physiology, Hokkaido University School of Medicine.

*Comparative Studies and Methods*

90 AMPLITUDE OF CIRCADIAN BODY TEMPERATURE AND PHASE ANGLE RELATIONSHIP OF TEMPERATURE/ACTIVITY RHYTHMS FOR CHIPMUNKS AND HAMSTERS UNDER TWO LEVELS OF ACTIVITY RESTRICTION. P.J. DeCoursey, C. Sandlin, S. Kribbs, C. Herren, and S. Pius. Department of Biological Sciences, University of South Carolina.

91 CIRCADIAN RHYTHMS IN A DIURNAL RODENT, *OCTODON DEGUS*, FOLLOWING A PHASE SHIFT OF THE LIGHTING SCHEDULE. Susan E. Labyak and Theresa M. Lee. Dept. of Psychology, University of Michigan.

92 CIRCADIAN RHYTHM OF BODY TEMPERATURE IN THE LIZARD *IGUANA IGUANA* IN CONSTANT CONDITIONS. Gianluca Tosini and Michael Menaker. Department of Biology and NSF Center for Biological Timing, University of Virginia.

93 ARVICANTHIS NILOTICUS: A NEW DIURNAL RODENT MODEL FOR CIRCADIAN RHYTHMS RESEARCH. Catherine Katona and Laura Smale. Dept. of Psychology, Michigan State University.

94 AN EXTRARETINAL PHOTORECEPTOR SYSTEM IN THE OPTIC LOBES OF BEETLES AND THEIR PUPAE - ITS ONTOGENY, FUNCTIONAL COMPARTMENTS AND POSSIBLE PHYSIOLOGICAL MEANING. Gerta Fleissner, Günther Fleissner, Verena Nink, and Anja Volz. Zoologisches Institut, JW Goethe-Universität Frankfurt/Main.

95 THE CIRCADIAN CONTROL SYSTEM OF THE CRICKET *TELEOGRYLLUS COMMODUS:* A SET OF WEAKLY COUPLED, BILATERALLY DISTRIBUTED PACEMAKERS. Gottfried Wiedenmann. Humboldt Universität zu Berlin, Institut für Verhaltensbiologie und Zoologie, and Freie Universität Berlin, Institut für Verhaltensbiologie.

96 INVESTIGATION OF COUPLED NEURONAL OSCILLATORS IN THE LEECH. C.G. Hocker and W.O. Friesen. Center for Biological Timing and Department of Biology, University of Virginia.

97 CIRCADIAN ABUNDANCE OF *psbA* mRNA IN UNICELLULAR CYANOBACTERIA UNDER DIFFERENT GROWTH CONDITIONS. Nadya Lebedeva*, Takao Kondo§, and Susan Golden*. *Dept. of Biology, Texas A&M University; §National Institute for Basic Biology.

98 TRAINING-TO-TESTING INTERVALS DIFFERENT FROM 24 HOURS IMPAIR LONG-TERM HABITUATION IN THE CRAB *CHASMAGNATHUS GRANULATUS*. Horacio O. de la Iglesia, Patricia Pereyra, and Héctor Maldonado. Laboratorio de Fisiología del Comportamiento Animal, Dpto. de Ciencias Biológicas, Universidad de Buenos Aires.

99 BLUE AND RED LIGHT PULSES AFFECT DELAYS AND ADVANCES DIFFERENTLY IN *GONYAULAX POLYEDRA*. Tzu-Shing Deng and Till Roenneberg. Institut für Medizinische Psychologie, Universität München.

100 TEMPORAL AND SPATIAL DISTRIBUTION OF *GONYAULAX POLYEDRA* IN CONSTANT RED LIGHT. Brigitte Eisensamer and Till Roenneberg. Institut für Medizinische Psychologie, Universität München.

101 A PROTEIN PHOSPHATASE INHIBITOR UNCOUPLES THE TWO CIRCADIAN OSCILLATORS OF *GONYAULAX POLYEDRA* IN WHITE LIGHT. Jalees Rehman and Till Roenneberg. Institut für Medizinische Psychologie, Universität München.

102 THE SHORT-TIME FOURIER TRANSFORM: A JOINT TIME-FREQUENCY ANALYSIS METHOD FOR RHYTHMIC DATA. M.E. Kleiderman, Y.A. Maksik, and R.M. Church. Walter S. Hunter Laboratory of Psychology, Brown University.

103 ANALYSIS BY PERIODOGRAMS OF THE EFFECT OF LIGHTING ON THE MOTOR CIRCADIAN RHYTHM. P. Ortega, B. Fuentes-Pardo*, F. Gutierrez-Zepeda, and J.A. Viccon-Pale. Depto. El Hombre y su Ambiente, DCBS; *Depto. de Fisiología, Fac. de Medicina.

104 IMPORTANCE OF 6 PM IN HAMSTER TIMEKEEPING AS SHOWN BY COMPUTER ANALYSIS OF WHEEL-RUNNING ACTIVITY. John J. Alleva, Frederic R. Alleva, James F. Pestaner, Judith M. McIntyre, and Dennis B. Wilson. Food and Drug Administration.

105 SOMNITOR: A NOVEL ACTIGRAPH DEVICE WITH A HEART RATE RECORDING. A. Oksenberg[2], E. Aron[2], Y. Pasternak[2], M. Laudon[1], and M. Zisapel[1]. [1]Dept. of Biochemistry, Tel Aviv University; and [2]Sleep Disorders Unit, Loewenstein Rehabilitation Hospital.

FRIDAY, MAY 6

08:00-10:00 Conference Room A
**Symposium 4**
**REM Sleep**

Chair: **William C. Dement**
Stanford University

Speakers: **Allan J. Hobson**
Harvard University
*The Long and Short of It: How Cholinergic Microstimulation of the Pons Enhances REM Sleep*

**Charles A. Czeisler**
Harvard University
*The Circadian Control of REM Sleep*

**Ralph Lydic**
Pennsylvania State University
*Pontine Cholinergic Neurotransmission: Relevance for Sleep and Respiratory Rhythm Generation*

**Gabrielle Brandenberger**
CNRS, Strasbourg
*Endocrine Concomitants of the REM-nonREM Sleep Cycle*

08:00-10:00 Conference Room B/C
**Symposium 5**
**Signal Transduction in the Suprachiasmatic Nucleus**

Chair: **Martha L. U. Gillette**
University of Illinois

Speakers: **Michael A. Rea**
Brooks Air Force Base
*Neurochemical Mechanisms Underlying Photic Phase Shifts*

**Rebecca A. Prosser**
University of Tennessee
*Intracellular Mechanisms Associated With Serotonergic Phase Shifts of the SCN*

**Martin Zatz**
NIMH
*Pathways from Light to Melatonin in the Chick Pineal*

**William J. Schwartz**
University of Massachusetts
*Intertwined Transcription Factors in the Rodent Circadian System*

08:00-10:00 Conference Room 4/5
**Symposium 6**
**Ultradian Circadian and Seasonal Endocrine Rhythms**

Chair: **Cheryl Sisk**
Michigan State University

Speakers: **Antonio A. Nunez**
Michigan State University
*Neurobiology of Photoperiod-dependent Seasonal Cycles*

**Phyllis M. Wise**
University of Kentucky
*Use of Antisense Oligonucleotides to Analyze the Regulation to Circadian Endocrine Rhythms*

**Suzanne M. Moenter**
UCSF
*Ultradian Rhythms of Gonadotropin-Releasing Hormone Secretion in the Ewe*

**Jeppe Sturis**
University of Chicago
*Rapid and Ultradian Oscillators in Insulin Secretion*

10:00-10:30 Coffee Break
Conference Center Patio

10:30-12:30 **The Society Symposium**
**"A Biennium of Progress: 1992-1994"**
Conference Room A-C

Co-Chairs: **Eve Van Cauter**
University of Chicago
**Robert Y. Moore**
University of Pittsburgh

Speakers: **Joseph S. Takahashi**
Northwestern University
*Clock Genetics and the Decade of the Mouse*

**Gene D. Block**
University of Virginia
*Unwinding the Snail's Clock: Reflections on a Decade of Escargot*

**James M. Krueger**
University of Tennessee
*Sleep is Important for the Immune System*

**Steven Reppert**
Harvard University
*The Molecular Biology of Melatonin Receptors*

**Rémy DeFrance**
Institut de Recherche
International Servier, Paris
*The Development of the First Chronobiotic Drugs*

12:30-16:30 Break
Take down Group A posters by 14:00
Put up Group B posters by 15:00

*Notice:* For those interested, a debate on "Patenting Specified Uses of Melatonin and Light: Facts and Evaluation" will be held in Conference Room A from 14:00-15:30. Chairs: Nicolas Mrosovsky & Eve Van Cauter.

16:30-18:30 Conference Room A-C
**Presidential Address**
**Robert Y. Moore, Chair**
**"Adventures in the Rhythm Trade"**
Introduction By: **Fred W. Turek**
Northwestern University

18:30-19:30 **Business Meeting**
Conference Room A-C

20:00-22:30 **Banquet**
Beach Club Deck/Pool

08:00- 10:00 Conference Room A
**Symposium 7**
**Identifying Pacemaker Neurons Within Pacemaker Tissue**

Chair: **Terry L. Page**
Vanderbilt University

Speakers: **Gregory M. Cahill**
University of Kansas
*A Circadian Oscillator in Xenopus Retinal Photoreceptors*

**Stephan Michel**
University of Virginia
*Isolation and Characterization of Pacemaker Neurons in Bulla*

**Kathleen K. Siwicki**
Swarthmore College
*Cells Labeled by Anti-per in Insects, Mollusks, and Mammals*

**Benjamin Rusak**
Dalhousie University
*Circadian Needles in the Suprachiasmatic Haystack*

08:00-10:00 Conference Room B/C
**Symposium 8**
**Implication of Circadian Rhythm Abnormalities in Depression**

Chair: **David J. Kupfer**
University of Pittsburgh

Speakers: **Ellen Frank**
University of Pittsburgh
*Biological Rhythms and Depression: The Role of Zeitgebers and Zeitstörers*

**Eve Van Cauter**
University of Chicago
*A Meta-Analysis of Cortisol Rhythm Abnormalities in Depression*

**Ronald Dahl**
University of Pittsburgh
*Sleep and Cortisol Regulation in Child and Adolescent Depression*

**Anna Wirz-Justice**
University of Basel
*Are Circadian Rhythms Involved in the Pathophysiology of SAD and Its Treatment by Light?*

08:00-10:00 Conference Room 4/5
**Symposium 9**
**Ontogeny of the Circadian System**

Chair: **Rae Silver**
Barnard College

Speakers: **Xianjie Yang**
Harvard University
*Determination of Cell Fate in Vertebrate Retina*

**Joan C. Speh**
University of Pittsburgh
*Development of the Mammalian Circadian Timing System*

**David Weaver**
Harvard University
*Development of Maternal and Photic Entrainment Mechanisms in Rats*

**Frederick C. Davis**
Northeastern University
*Entrainment for Development*

10:00-10:30 Coffee Break
Conference Center Patio

10:30-12:30 Conference Room A
**Slide Session 6**
**Sleep, Sleepiness and Mood**
Chair: Daniel F. Kripke

10:30
106 24-HOUR DISTRIBUTION OF EEG POWER DENSITY IN THE 7/13 SLEEP-WAKE PARADIGM AFTER EVENING BRIGHT/DIM LIGHT EXPOSURE. O. Tzischinsky[1], A. Shlitner[2], and P. Lavie[2]. [1]E.P. Bradley Hospital Sleep Research Laboratory, Brown University School of Medicine; [2]Sleep Laboratory, Faculty of Medicine, Technion - Israel Institute of Technology.

10:45

107 POLYPHASIC SCHEDULES UNDER SLEEP REDUCTION: EFFECTS ON SLEEP ARCHITECTURE. Claudio Stampi, Anneke Heitmann, Acacia Aguire, and Patricia Tassi. Institute for Circadian Physiology, Cambridge, MA.

11:00

108 NAPPING AS A FUNCTION OF TIME OF DAY PERFORMANCE MEASURES OF SLEEP INERTIA. Valerie Gil, Franklin A. Lue, Harvey Moldofsky, Robert Angus, and Manny Radomski. University of Toronto Centre for Sleep and Chronobiology, The Toronto Hospital.

11:15

109 EFFECTS OF EXPOSURE TO LIGHT OR EXERCISE ON SLEEPINESS AND PERFORMANCE DURING CONSTANT ROUTINE CONDITIONS. Rachel Leproult, Oliver Van Reeth, Maria M. Byrne, Jeppe Sturis, and Eve Van Cauter. Department of Medicine, University of Chicago - and - Center for Biological Rhythms, Université Libre de Bruxelles.

11:30

110 ENDOGENOUS CIRCADIAN RHYTHM OF SUBJECTIVE MOOD IN HEALTHY YOUNG MEN. Diane B. Boivin, Jeanne F. Duffy, Derk-Jan Dijk, Julie A. Smith, and Charles A. Czeisler. Laboratory for Circadian and Sleep Disorders Medicine, Harvard Medical School, Brigham and Women's Hospital.

11:45

111 RELATIONSHIP BETWEEN BODY TEMPERATURE AND ESTIMATED INTERVAL DURATION. Jason M. Birnbaum and Scott S. Campbell. Human Chronobiology Lab, Dept. of Psychiatry, Cornell Medical School.

12:00

112 MOTOR ACTIVITY RHYTHMS IN BIPOLAR DISORDER: RELATIONS WITH EEG SLEEP AND CLINICAL COURSE. Eric A. Nofzinger, Ellen Frank, and David J. Kupfer. Sleep and Chronobiology Center, Western Psychiatric Institute and Clinic, University of Pittsburgh School of Medicine.

12:15

113 ILLUMINATION EXPERIENCE AND POMS SCORES. D.F. Kripke, J.A. Wisbey, P.J. Hauri, R.J. Cole, and M.R. Klauber. Departments of Psychiatry and Family and Preventive Medicine, UCSD and Mayo Sleep Disorders Center, Mayo Clinic.

10:30-12:30 Conference Room B

**Slide Session 7**

**Entrainment Pathways and Mechanisms**

Chair: Michael A. Rea

10:30

114 MORPHOLOGY AND DISTRIBUTION OF RETINAL GANGLION CELLS PROJECTING TO THE SUPRACHIASMATIC NUCLEUS. H.M. Cooper, A. Tessonneaud, M. Caldani, A. Locatelli, and M.C. Viguier-Martinez. Cerveau et Vision; Lab. Neuroendocrinol. Univ. de Tours, Fac. Sciences; INRA Lab. Neuroendocrinol. Sexuelle.

10:45

115 FUNCTIONAL DISSECTION OF CENTRAL VISUAL PROJECTION SYSTEMS WITH ALPHA HERPES VIRUSES. J. Patrick Card, Joan C. Speh, and Robert Y. Moore. Departments of Behavioral Neuroscience, Psychiatry and Neurology, University of Pittsburgh.

11:00

116 INJECTIONS OF GRP INTO THE SUPRACHIASMATIC NUCLEUS INDUCE PHASE SHIFTS REGARDLESS OF CONSTANT LIGHTING CONDITIONS. Hugh D. Piggins[1,2], Michael Antle[1], and Benjamin Rusak[1]. Departments of Psychology[1] and Anatomy & Neurobiology[2], Dalhousie University.

11:15

117 LIGHT-INDUCED PHASE SHIFTS OF THE MAMMALIAN CIRCADIAN SYSTEM CAN BE BLOCKED BY INTRAVENTRICULAR APPLICATION OF ANTISENSE OLIGONUCLEOTIDES. F. Wollnik[1], F. Gillardon [2], R. Bravo[3], M. Zimmermann[2], W. Brysch[4], K.H. Schlingensiepen[4], and T. Herdegen[2], [1]University of Konstanz, Dept. of Biology; [2]University of Heidelberg, Institute of Physiology II; [3]Bristol-Myers Squibb Pharmacological Research Institute; [4]Max-Planck-Institute for Biophysical Chemistry.

11:30

118 BAD GENES COME OUT AT NIGHT: LIGHT INDUCES BAD2, A MAP KINASE PHOSPHATASE, AS AN IMMEDIATE-EARLY GENE IN THE SUPRACHIASMATIC NUCLEUS OF HAMSTER AND RAT. Jon M. Kornhauser, Alison Opper, Zhuo Qian*, Kelly E. Mayo, Eric R. Kandel*, and Joseph S. Takahashi. NSF Center for Biological Timing, Northwestern University; *Center for Neurobiology and Behavior, and Howard Hughes Medical Institute, College of Physicians and Surgeons of Columbia University.

11:45

119 EFFECTS OF CYCLOHEXIMIDE ON LIGHT-INDUCED PHASE-ADVANCES IN THE LOCOMOTOR ACTIVITY RHYTHM OF THE HAMSTER. Yan Zhang, Marina Seme, Joseph S. Takahashi, and Fred W. Turek. NSF Center for Biological Timing, Northwestern University.

12:00

120 NITRIC OXIDE MEDIATES GLUTAMATE-INDUCED PHASE SHIFTS IN THE RAT SCN. J.M. Ding, D. Chen, L.E. Faiman, and M.U. Gillette. Depts. of Cell & Structural Biology, Physiology and the Neuroscience Program, University of Illinois.

12:15

121 SEROTONERGIC MODULATION OF PHOTIC INPUT TO THE SCN CIRCADIAN PACEMAKER. J.D. Glass, M. Selim, U.E. Hauser, G. Srkalovic, and M.A. Rea[1]. Dept. of Biological Sciences, Kent State University; [1]Circadian Neurobiology Research Group, Armstrong Laboratory, Brooks AFB.

10:30-12:30 Conference Room C

**Slide Session 8**

**Molecular Mechanisms**

Chair: Michael Rosbash

10:30

122 CIRCADIAN CYCLING OF *PERIOD* mRNA IN BODY TISSUES SUGGESTS THAT MULTIPLE CIRCADIAN OSCILLATORS ARE PRESENT IN *DROSOPHILA*. Paul E. Hardin. Department of Biology and Institute of Biosciences and Technology, Center for Advanced Invertebrate Molecular Sciences, Texas A&M University.

10:45

123 *DROSOPHILA* BEARING HEAT-INDUCIBLE COPIES OF THE *PERIOD* GENE MANIFEST CIRCADIAN RHYTHMS WITH WILD TYPE PERIODS YET SIGNIFICANTLY DELAYED PHASES: UNCOUPLING PERIOD LENGTH FROM PHASE-SETTING. Isaac Edery[1], Kathy Curtin, Hongkui Zeng, and Michael Rosbash. HHMI and Dept. of Biology, Brandeis University; [1]Present address: Dept. of Mol. Biol. and Biochem., Center for Adv. Biotech. and Med., Rutgers University.

11:00

124 THE *DROSOPHILA* CLOCK MUTATION *TIMELESS* AFFECTS ABUNDANCE OF WILD TYPE *PERIOD* PROTEIN. Jeffrey L. Price*, Marie E. Dembinska+, Michael W. Young*, and Michael Rosbash+. *Howard Hughes Medical Institute, National Science Foundation Science and Technology Center for Biological Timing, and Laboratory of Genetics, Rockefeller University; +Howard Hughes Medical Institute, National Science Foundation Science and Technology Center for Biological Timing, and Department of Biology, Brandeis University.

11:15

125 CIRCADIAN REGULATION OF A DAILY RHYTHM OF RELEASE OF PROTHORACICOTROPIC HORMONE FROM THE BRAIN OF THE INSECT RHODNIUS PROLIXUS. X. Vafopoulou and C.G.H. Steel. Department of Biology, York University.

11:30

126 CIRCADIAN REGULATION OF CATALASE EXPRESSION IN *ARABIDOPSIS*. Hai Hong Zhong and C. Robertson McClung. Department of Biological Sciences, Dartmouth College.

11:45

127 *IN VITRO* RHYTHMS OF TRYPTOPHAN HYDROXYLASE MESSENGER RNA IN *XENOPUS LAEVIS* PHOTORECEPTORS. C.B. Green, G.M. Cahill, and J.C. Besharse. Dept. of Anatomy and Cell Biology, University of Kansas Medical Center.

12:00

128 IDENTIFICATION OF CDK-LIKE PROTEINS IN THE EYE AND BRAIN OF THE MARINE SNAIL, BULLA GOULDINA. Nancy A. Krucher and Michael H. Roberts. Department of Biology, Clarkson University.

12:15

129 CIRCADIAN BINDING OF A PROTEIN TO THE 3' UNTRANSLATED REGION OF THE LUCIFERIN BINDING PROTEIN mRNA FROM *GONYAULAX*. M. Mittag, D.H. Lee, and J.W. Hastings. Departments of Biochemistry, Molecular, Cellular and Developmental Biology, Harvard University.

10:30-12:30 Conference Room 4/5
**Slide Session 9**
**Melatonin and Rhythm Regulation**
Chair: Nava Zisapel

10:30

130 RECIPROCAL MODULATION OF BRAIN MELATONIN AND BENZODIAZEPINE BINDING SITES BY CHRONIC DIAZEPAM AND MELATONIN ADMINISTRATION. N. Zisapel[1], M. Laudon[1], S. Oaknin[3], S. Laschiner[4], M. Gavish[4], and J. Atsmon[2]. [1]Department of Biochemistry, Faculty of Life Sciences and [2]Clinical Pharmacology Unit, Wolfson Medical Center and Sackler Medical School, Tel Aviv University; 3Department of Biochemistry, University of La Laguna; and [4]Department of Pharmacology, Rapaport Faculty of Medicine.

10:45

131 AGONIST-STIMULATED PHOSPHORYLATION OF CREB IN OVINE PARS TUBERALIS IS MELATONIN-SENSITIVE AND OCCURS BY CYCLIC AMP-DEPENDENT AND INDEPENDENT PATHWAYS. S. McNulty, K.Y. Shiu, and M.H. Hastings. Department of Anatomy, University of Cambridge.

11:00

132 ZEBRAFISH CIRCADIAN RHYTHMS: LOCOMOTOR ACTIVITY AND MELATONIN RELEASE BY CULTURED RETINA AND PINEAL. Gregory M. Cahill and Abigail Hankin. Department of Anatomy and Cell Biology, University of Kansas Medical Center.

11:15

133 THE EFFECT OF THE TAU MUTATION ON GONADAL RESPONSES TO SD-LIKE PROGRAMMED MELATONIN INFUSIONS IN THE SYRIAN HAMSTER. J.A. Stirland, J. Grosse*, A.S.I. Loudon, M.H. Hastings*, and E.S. Maywood*. Institute of Zoology and *Dept. of Anatomy, University of Cambridge.

11:30

134 CIRCADIAN RHYTHMS OF ACTIVITY AND FEEDING IN THE AGED RAT: EFFECTS OF MELATONIN ADMINISTRATION. Nigel R. Oakley and Russell M. Hagan. Pharmacology Dept., Glaxo Research and Development Ltd.

11:45

135 ACUTE TREATMENT WITH MELATONIN DURING ESTRUS ALTERS PLASMA ESTRADIOL AND PROGESTERONE IN THE PONY MARE. Brian D. Cleaver and Dan C. Sharp. Animal Science Dept., University of Florida.

12:00

136 DURATION-VARIABLE MELATONIN SIGNAL ACTS DIRECTLY IN THE PITUITARY GLAND TO MEDIATE EFFECTS OF PHOTOPERIOD IN THE RAM. G.A. Lincoln[a] and I.J. Clarke[b]. [a]MRC Reproductive Biology Unit; [b]Prince Henry's Institute of Medical Research.

12: 15

137 INFUSION OF MELATONIN DURING THE LIGHT PHASE DOES NOT ALTER THE DAILY LOCOMOTOR ACTIVITY PATTERN IN THE SOAY RAM. T. Sweeney[a], A.M. Strijkstra[b], and G.A. Lincoln[c]. [a]Faculty of Veterinary Medicine, University College Dublin; [b]Zoology Laboratory, University of Groningen; and [c]MRC Reproductive Biology Unit.

12:30-15:30 Break

15:30-17:30 Conference Room A
**Workshop 5**
**State Variables and Feedback Regulated Genes**

Discussion Leader: **Paul Hardin**
Texas A&M University

Paolo Sasson-Corsi
Steven M. Reppert
Martha Merrow
Maja Buçan

15:30-17:30 Conference Room B
**Workshop 6**
**Photoreceptors in Vertebrate Circadian Systems**

Discussion Leader: **Michael Menaker**
University of Virginia

Shizufumi Ebihara
Howard M. Cooper
Rae Silver
Gerta Fleissner
Gunther Fleissner
Russell G. Foster
Charlene Argamaso
Iggy Provencio
Marianna Max
Michael S. Grace
Gregory M. Cahill
Martin Zatz

15:30-17:30 Conference Room C
**Workshop 7**
**Chronobiological Basis for Cancer Therapy**

Discussion Leader: **William J.M. Hrushesky**
Albany Medical College

Robert Klevecz
Robert Diasio
Georg Bjarnason
Patricia A. Wood

15:30-17:30 Conference Room 4/5
**Workshop 8**
**Type 0 or Type 1 Resetting by Light in Mammals: Are They Really Incompatible?**

Discussion Leader: **Benjamin Rusak**
Dalhousie University

Serge Daan
Jeffrey Elliott
Jeppe Sturis
Sato Honma
Megan Jewett
Theresa Shanahan

17:30-19:30 **Poster Presentations, Group B**
Conference Room 1-3

*Human Rhythms and Their Regulation*

138 GREATER HYPOGLYCEMIC EFFECT OF ULTRADIAN OSCILLATORY INSULIN DELIVERY THAN OF CONSTANT ADMINISTRATION. Jeppe Sturis, André J. Scheen, Kenneth S. Polonsky, and Eve Van Cauter. Department of Medicine, University of Chicago and Division of Diabetes, Nutrition and Metabolic Diseases, CHU Liège.

139 EFFECTS OF AGE AND DEGREE OF OBESITY ON GLUCOSE TOLERANCE DURING SLEEP. Samuel A. Frank, Maria M. Byrne, Jeppe Sturis, Kenneth S. Polonsky, and Eve Van Cauter. Department of Medicine, University of Chicago.

140 A MATHEMATICAL MODEL FOR THE ANALYSIS OF DIURNAL CORTISOL PATTERNS. Emery N. Brown, Patricia M. Meehan, Arthur P. Dempster, and Charles A. Czeisler. Statistics Research Laboratory, Department of Anesthesia, Massachusetts General Hospital; Department of Statistics, Harvard University; Laboratory for Circadian and Sleep Disorders Medicine, Brigham and Women's Hospital and Harvard Medical School.

141 A META-ANALYSIS OF THE 24-HOUR PROFILE OF PLASMA CORTISOL IN NORMAL MAN: EVIDENCE FOR AGE-RELATED ALTERATIONS IN CIRCADIAN PHASE AND AMPLITUDE. Eve Van Cauter and Rachel Leproult. Department of Medicine, University of Chicago and Center for Biological Rhythms, Universite Libre de Bruxelles.

142 A PHYSIOLOGICALLY-BASED CONNECTIONIST NETWORK MODEL OF FUNCTIONAL REGULATORY INTERACTIONS CONTROLLING GROWTH HORMONE SECRETORY DYNAMICS. Martin Straume[1,2,4], Lubin Chen[4], Johannes D. Veldhuis[1,2,4], and Michael L. Johnson[1,2,3,4]. [1]NSF Center for Biological Timing; Departments of [2]Medicine and [3]Pharmacology; [4]Interdisciplinary Biophysics Program; University of Virginia.

143 A COMPARISON OF THE MELATONIN ONSET AND ACROPHASE AS MARKERS FOR CIRCADIAN PHASE. M.L. Blood, R.L. Sack, G. Sexton, and A.J. Lewy. Sleep and Mood Disorders Laboratory, Oregon Health Sciences University.

144 A MATHEMATICAL MODEL OF DIURNAL VARIATION IN HUMAN PLASMA MELATONIN LEVELS. Yong Choe, Emery N. Brown, Theresa L. Shanahan, and Charles C. Czeisler. Statistics Research Laboratory, Department of Anesthesia, Massachusetts General Hospital; Laboratory for Circadian and Sleep Disorders Medicine, Brigham and Women's Hospital and Harvard Medical School.

145 EFFECTS OF A SINGLE LATE AFTERNOON MELATONIN TREATMENT ON CORE BODY TEMPERATURE AND THE ENDOGENOUS MELATONIN RHYTHM. J. English, S. Deacon, and J. Arendt. School of Biological Sciences, University of Surrey.

146 S-20098, A MELATONIN AGONIST, HAS HYPOTHERMIC EFFECTS AFTER SINGLE MORNING ORAL ADMINISTRATION IN HUMANS. O. Van Reeth, D. Sawyers, R. Leproult, E. Olivares, and G. Lapeyre. CERB, Faculté de Médecine, Université Libre de Bruxelles; Guy's Research Unit; Institut de Recherches Internationales Servier.

147 USE OF MELATONIN TO ADAPT TO PHASE-SHIFTS, I. MELATONIN COUNTERS SLEEP PROBLEMS AFTER A LARGE ADVANCE SHIFT IN EXTERNAL TIME CUES IN SPITE OF AMBIENT LIGHT CONDITIONS. S. Deacon and J. Arendt. School of Biological Sciences, University of Surrey.

148 USE OF MELATONIN TO ADAPT TO PHASE-SHIFTS, II. MOOD AND PERFORMANCE AFTER A LARGE ADVANCE SHIFT IN EXTERNAL TIME CUES. J. Arendt and S. Deacon. School of Biological Sciences, University of Surrey.

149 ARE CIRCADIAN RHYTHMS INVOLVED IN THE PATHOPHYSIOLOGY OF SAD AND ITS TREATMENT BY LIGHT? Anna Wirz-Justice, Kurt Kräuchi, Peter Graw, Josephine Arendt*, Judie English*, Hans-Joachim Haug, Georg Leonhardt, and Daniel P. Brunner. Psychiatric University Clinic, Switzerland and *Dept. of Clinical Biochemistry, University of Surrey.

150 NATURAL ILLUMINATION OF NORMAL SUBJECTS IN THE WINTER. Marc Hébert, Marie Dumont, Julie Carrier, and Josée Guillemette. Laboratoire de Chronobiologie, Hôpital Sacré-Couer & Université de Montréal.

151 CIRCADIAN FUNCTION IN NURSING HOME PATIENTS. S. Ancoli-Israel, D. Jones, J. Martin, and W.J. Mason. Department of Psychiatry, UCSD, La Jolla.

152 EFFECT OF CONTINUOUS BRIGHT LIGHT DURING NIGHT TIME (20:00-08:00) ON THE RECTAL TEMPERATURE DURING A 36-H CONSTANT ROUTINE AND THE RECOVERY NIGHT. A. Aguirre, J. Foret, A. Daurat, and O. Benoit. Laboratoire d' Etude du Sommeil.

153 A MODEL FOR A SATURATING RESPONSE OF THE CIRCADIAN PACEMAKER TO LIGHT. Richard E. Kronauer. Div. of Applied Sciences, Harvard University; Charles A. Czeisler, Harvard Medical School, Brigham & Women's Hospital.

154 DELTA WAVE NAP IN SLEEP CIRCADIAN MODEL. Bahram Bolouri and Amir H. Hadjtarkhani. Sleep Research Laboratory, Center for Basic Medical Sciences, Iran University of Medical Sciences.

155 ENDOCRINE CONCOMITANTS OF THE REM-NREM SLEEP CYCLES. G. Brandenberger. Laboratoire de Physiologie et de Psychologie Environnementales.

156 PROCESS MODELLING IN THE SLEEP-WAKE CYCLE. Simon Folkard and Torbjorn Akerstedt. Shiftwork Research Team, MRC/ESRC Social and Applied Psychology Unit and Department of Clinical Neuroscience, Stress Research Section, Karolinska Institute.

*Suprachiasmatic Nucleus and Circadian Function*

157 ONTOGENY OF TYROSINE HYDROXYLASE-IMMUNOREACTIVE NEURONS AND FIBERS IN THE FETAL AND NEONATAL HAMSTER SCN. Wendy N. Strother and Michael N. Lehman. Dept. of Anat. and Cell Biol., Univ. of Cincinnati College of Medicine.

158 D- 1 DOPAMINE RECEPTOR AGONIST SKF 38393 INDUCES FOS-LIKE IMMUNO-REACTIVITY IN THE FETAL HAMSTER SCN. N. Viswanathan, P. Snodgrass, and F.C. Davis. Department of Biology, Northeastern University.

159 COCAINE INDUCES TRANSIENT EXPRESSION OF *c-fos* AND *jun-B* mRNAs IN THE FETAL RAT SUPRACHIASMATIC NUCLEI (SCN). David R. Weaver, Alfred L. Roca, and Steven M. Reppert. Laboratory of Developmental Chronobiology, Children's Service, Massachusetts General Hospital; Dept. of Pediatrics & Program in Neuroscience, Harvard Medical School.

160 ATTEMPTS TO INDUCE FREE-RUN OF FOOD-ENTRAINED RHYTHMS USING D20 AND METHAMPHETAMINE. Ralph Mistlberger, Elliott Marchant, and Tod Kippin[1]. Psychology, Simon Fraser University and [1] Psychology, University of British Columbia.

161 CIRCADIAN PHOTORECEPTION IN THE RETINALLY DEGENERATE CBA MOUSE. Susan Doyle, Wendy Irelan, Takashi Yoshimura*, Shizufumi Ebihara*, and Russell G. Foster. Department of Biology, University of Virginia; *Department of Animal Physiology, Faculty of Agriculture, Nagoya University.

162 IDENTIFICATION OF RETINAL GANGLION CELLS PROJECTING TO THE LATERAL HYPOTHALAMIC AREA OF THE RAT. Rehana K. Leak, Joan C. Speh, and Robert Y. Moore. Center for Neuroscience, University of Pittsburgh.

163 NITRIC OXIDE SYNTHASE INHIBITOR BLOCKS LIGHT-INDUCED PHASE SHIFTS OF THE FREE-RUNNING ACTIVITY RHYTHM IN HAMSTERS. E.T. Weber, M.U. Gillette, and M.A. Rea. Departments of Physiology and Biophysics, and Cell and Structural Biology, University of Illinois at Urbana-Champaign, and Circadian Neurobiology Research Group, Armstrong Laboratory, Brooks AFB.

164 INHIBITION OF GABA TRANSAMINASE ENHANCES LIGHT-INDUCED CIRCADIAN PHASE DELAYS BUT NOT ADVANCES. Diego A. Golombek and Martin R. Ralph. Department of Psychology, University of Toronto.

165 EFFECTS OF LIGHT ON THE INDUCTION OF FOS-LIKE PROTEIN IN THE SUP-RACHIASMATIC NUCLEUS AND LOCOMOTOR ACTIVITY RHYTHM IN DIURNAL CHIPMUNK. Hiroshi Abe, Sato Honma, Kazuyuki Shinohara, and Ken-ichi Honma. Department of Physiology, Hokkaido University School of Medicine.

166 CIRCADIAN RHYTHMS OF cAMP LEVEL AND cAMP RESPONSIVE ELEMENT (CRE) BINDING IN THE SUPRACHIASMATIC NUCLEUS. Shin-Ichi T. Inouye, Jing Yang, Shin Yamazaki, and Akira Sakai. Mitsubishi Kasei Institute of Life Sciences.

167 PHOTIC AND CIRCADIAN REGULATION OF *nur77* AND *zif*268 GENE EXPRESSION IN THE HAMSTER SUPRACHIASMATIC NUCLEUS. James T. Lin, Jon M. Kornhauser, Nicole P. Singh, and Joseph S. Takahashi. NSF Center for Biological Timing, Northwestern University.

168 AFFERENT CONNECTIONS OF THE SUPRACHIASMATIC NUCLEUS IN THE RAT: A STUDY USING BOTH ANTEROGRADE AND RETROGRADE NEURONAL TRACERS. M.M. Moga, J.C. Speh, and R.Y. Moore. Center for Neuroscience, University of Pittsburgh.

169 ARE GLIA AMONG THE CELLS THAT EXPRESS FOS-LIKE PROTEINS IN THE SUPRACHIASMATIC NUCLEUS (SCN)? M.R. Bennett, N. Aronin*, and W.J. Schwartz. Depts. of Neurology and *Medicine, University of Massachusetts Medical School.

170 ASTROCYTES AND THE ENTRAINMENT OF THE CIRCADIAN CLOCK BY LIGHT: POSTNATAL DEVELOPMENT STUDY IN THE GOLDEN HAMSTER. M. Lavialle and J. Servière. INRA, INSERM.

171 DISTRIBUTION AND DAILY FLUCTUATION OF GFAP IMMUNOREACTIVE ASTROCYTES IN THE CHICK VISUAL SUPRACHIASMATIC NUCLEUS. Wade S. Warren, Cyd L. Cassone, Jun Lu, and Vincent M. Cassone. Department of Biology, Texas A&M University.

172 CAN GFAP FLUCTUATIONS CONSTITUTE A NOVEL INDEX OF ACTIVITY OF THE CIRCADIAN CLOCK IN RODENTS? J. Servière*, M. Touret#, and M. Lavialle*. *INRA; #U52 INSERM.

173 SPECIALIZED NEURONAL AND GLIAL CONTRIBUTIONS TO DEVELOPMENT OF THE LATERAL GENICULATE COMPLEX AND CIRCADIAN VISUAL SYSTEM. L.P. Morin and G.I. Botchkina. Dept. of Psychiatry, Stony Brook University.

174 CIRCADIAN VARIATION IN WAKE AND SLEEP BOUT-LENGTHS: EVIDENCE FOR SCN-DEPENDENT ALERTING IN THE RAT. W.F. Seidel, W.C. Dement, and D.M. Edgar. CSCN, Dept. of Psychiatry & Behavioral Sciences, Stanford University School of Medicine.

175 THE SUPRACHIASMATIC NUCLEUS (SCN) MEDIATES CIRCADIAN RHYTHMS OF BODY TEMPERATURE AND CIRCANNUAL RHYTHMS OF HIBERNATION AND BODY MASS IN GOLDEN-MANTLED GROUND SQUIRRELS. Norman F. Ruby[1], John Dark[2], H. Craig Heller[1], and Irving Zucker[2]. [1]Dept. of Biological Sciences, Stanford University; [2]Dept. of Psychology, University of California, Berkeley.

176 SPONTANEOUS ELECTRICAL ACTIVITY IN NEURONS CULTURED FROM RAT SUPRACHIASMATIC NUCLEUS. David K. Welsh[1,2,3], Diomedes E. Logothetis[2], and Steven M. Reppert[1,3]. Developmental Chronobiology, Massachusetts General Hospital[1], Department of Cardiology, Children's Hospital[2]; and Program in Neuroscience, Harvard Medical School[3].

177 AN ELECTROPHYSIOLOGICAL STUDY OF THE *TAU* MUTANT SYRIAN HAMSTER SUPRACHIASMATIC NUCLEUS (SCN) *IN VITRO*: EVIDENCE FOR A RHYTHM OF SPONTANEOUS NEURONAL DISCHARGE ACTIVITY WITH A PERIOD LESS THAN 24 HOURS. I.R. Davies and R. Mason. Department of Physiology and Pharmacology, University of Nottingham Medical School, Queens Medical Centre.

178 ANALYSIS OF THE PHASE SHIFTING EFFECTS OF GASTRIN RELEASING PEPTIDE (GRP) INJECTED INTO THE SUPRACHIASMATIC NUCLEUS (SCN). H.E. Albers, C.F. Gillespie and T.O. Babagbemi. Lab. of Neuroendocrinol. & Behav., Georgia State University.

179 CALCIUM IMAGING IN ORGANOTYPIC CULTURES OF RAT AND MOUSE SUPRACHIASMATIC NUCLEI. Michael Geusz, Keiko Tominaga, Stephan Michel, and Shin-Ichi Inouye. NSF Center for Biological Timing, Department of Biology, University of Virginia.

180 VASOPRESSIN AND VASOACTIVE-INTESTINAL PEPTIDE IN THE PERIFUSATE MEDIUM OF RAT SUPRACHIASMATIC NUCLEUS EXPLANT CULTURE. Y. Isobe. Department of Physiology, Nagoya City University Medical School.

181 PACEMAKER-PACEMAKER COMMUNICATION IN HAMSTERS WITH SCN TRANSPLANTS. Mark W. Hurd[1], Diego A. Golombek[1], Michael N. Lehman[2], and Martin R. Ralph[1]. [1]Department of Psychology, University of Toronto; [2]Department of Anatomy and Cell Biology, University of Cincinnati College of Medicine.

182 MULTIPLE SOMATOSTATIN RECEPTOR SUBTYPE GENES ARE EXPRESSED IN THE SUPRACHIASMATIC NUCLEUS OF RATS. Jacob P. Harney and Phyllis M. Wise. Department of Physiology, University of Kentucky College of Medicine.

183 DO TIMED INJECTIONS OF D l-DOPAMINE RECEPTOR AGONIST SET THE PHASE OF CIRCADIAN RHYTHMS RESTORED BY FETAL SCN GRAFTS? Ryan R. Walsh, Wendy N. Strother, David R. Osterhus, Charles C. Kim, and Michael N. Lehman. Dept. of Anat. & Cell Biol., University of Cincinnati College of Medicine.

184 AGING ABOLISHES THE DIURNAL RHYTHM OF CORTICOTROPIN RELEASING HORMONE GENE EXPRESSION IN THE PARAVENTRICULAR NUCLEI. Aihua Cai*, Teresa M. McShane+, and Phyllis M. Wise+. *Department of Physiology, University of Maryland at Baltimore; +Department of Physiology, University of Kentucky.

185 WAVELENGTH DEPENDENCE OF LIGHT-INDUCED PHASE SHIFTS AND PERIOD CHANGES IN HAMSTERS. Ziad Boulos. Institute for Circadian Physiology.

186 CIRCADIAN RHYTHMS OF EXTRACELLULAR GLUTAMATE AND ASPARTATE IN THE VICINITY OF THE RAT SUPRACHIASMATIC NUCLEUS. Sato Honma, Yumiko Katsuno, Hiroshi Abe, Kazuyuki Shinohara, and Ken-ichi Honma. Department of Physiology, Hokkaido University School of Medicine.

*Photoperiodism and Seasonal Cycles*

187 CAN THE *PARS TUBERALIS* MEASURE PHOTOPERIODIC TIME? David G. Hazlerigg*#, Michael H. Hastings *, and Peter J. Morgan#. *Dept. of Anatomy, University of Cambridge and #Molecular Neuroendocrinology Group, The Rowett Institute.

188 PHOTOPERIOD AND LINEAGE DEPENDENT EFFECTS OF MELATONIN IN SIBERIAN HAMSTERS *(PHODOPUS SUNGORUS)*. Kristina M. Stanfield and Teresa H. Horton. Dept. of Biological Sciences, Kent State University.

189 TYPE 0 PRC IN HAMSTERS: INFLUENCE OF PHOTOPERIOD AND DIM NOCTURNAL ILLUMINATION. J.A. Elliott. Stanford University and UCSD School of Medicine.

190 PATTERNS OF FISH AND PRL DURING PINEALECTOMY-INDUCED GONADAL DEVELOPMENT IN SIBERIAN HAMSTERS. K.K. Kelly, B.D. Goldman, and I. Zucker. Dept. of Psychology, University of California, Berkeley; Physiology and Neurobiology, University of Connecticut.

191 THE EFFECTS OF SOCIAL STIMULI ON FOLLICLE DEVELOPMENT AND BRAIN CONTENT OF cGnRH-I IN FEMALE STARLINGS IN DIFFERENT PHOTOPERIODS. Gregory F. Ball, Hannah R. Besmer, Qichang Li*, and Mary Ann Ottinger*. Behavioral Neuroendocrinology Group, Department of Psychology, Johns Hopkins University; *Department of Poultry Science, University of Maryland.

192 PHOTOPERIOD EXPOSURE INFLUENCES TYROSINE HYDROXYLASE IMMUNOLABELLING IN THE ARCUATE NUCLEUS OF MALE HAMSTERS. K. Krajnak and A.A. Nunez. Department of Psychology and Neuroscience Program, Michigan State University.

193 PHOTOPERIODIC AND OVARIAN INFLUENCES ON BLOOD PLASMA LUTEINIZING HORMONE LEVELS OF PRAIRIE VOLES *(MICROTUS OCHROGASTER)*. Randy J. Nelson and Christopher A. Moffatt*. Behavioral Neuroendocrinology Group, Department of Psychology, Johns Hopkins University, and *Neuroscience and Behavior Program, Department of Psychology, University of Massachusetts.

194 AN ENDOGENOUS CIRCANNUAL RHYTHM OF REPRODUCTION IN A TROPICAL BAT, ANOURA GEOFFROYI, IS NOT ENTRAINED BY PHOTOPERIOD. Paul D. Heideman and F.H. Bronson. Institute of Reproductive Biology and Department of Zoology, University of Texas at Austin.

195 PHOTOPERIODIC INDUCTION OF THE GROWTH RATE AND SEXUAL MATURATION OF THE CRAYFISH DURING ONTOGENY. M.L. Fanjul-Moles, O. Castañón-Cervantes and C.M. Lugo-Pérez. Lab. Neurofisiologia Comparada, Depto. Biología, Facultad de Ciencias.

196 THE EFFECTS OF AGE AND SEASON ON ACTIVATION AND CYTOSKELETAL FUNCTION IN RESTING T LYMPHOCYTES FROM MICE. Mary Anne Brock. Gerontology Research Center, National Institute on Aging.

197 ANNUAL CYCLE OF REPRODUCTIVE PHYSIOLOGY IN AN OPPORTUNISTIC BREEDER, THE RED CROSSBILL, *LOXIA CURVIROSTRA* (AVES: CARDUELINAE). T.P. Hahn. Dept. of Zoology, Univ. of Washington.

*Melatonin*

198 MOLECULAR CLONING OF A HIGH-AFFINITY MELATONIN RECEPTOR cDNA FROM *XENOPUS* MELANOPHORES. Takashi Ebisawa, Suresh Karne*, Michael R. Lerner*, and Steven M. Reppert. Laboratory of Developmental Chronobiology, Massachusetts General Hospital and Harvard Medical School and *Yale University School of Medicine.

199 DEVELOPMENT OF 2-[$^{125}$I]-IODO-MELATONIN BINDING IN EMBRYONIC CHICK BRAIN. David S. Brooks, Andrea J. Mitchell, and Vincent M. Cassone. Department of Biology, Texas A&M University.

200 REGULATION OF PINEAL MELATONIN RELEASE BY PACAP: EVIDENCE FOR PACAP RECEPTORS. J. Olcese, E. Maronde, and R. Ivell. Institute for Hormone & Fertility Research, University of Hamburg.

201 EFFECTS OF MELATONIN INFUSIONS ON RHYTHMICITY IN PIGEONS UNDER A LIGHT-DARK CYCLE. Eric M. Mintz and Ralph J. Berger. Department of Biology, Sinsheimer Laboratories, University of California, Santa Cruz.

202 PINEAL MELATONIN RESPONSES TO LIGHT PERCEIVED BY THE EYES IN THE PIGEON: IN VIVO MICRODIALYSIS STUDIES. Minoru Hasegawa, Akihito Adachi, Takashi Yoshimura, and Shizufumi Ebihara. Dept. of Animal Physiology, Nagoya University.

203 INFLUENCE OF DAILY MELATONIN TREATMENTS ON THE CIRCADIAN MELATONIN RHYTHM. S.M. Yellon. Division of Perinatal Biology, Departments of Physiology and Pediatrics, Loma Linda University School of Medicine.

204 MELATONIN ACTIVATES AN OUTWARD CURRENT IN A SUBPOPULATION OF RAT SUPRACHIASMATIC NUCLEUS NEURONS (SCN) *IN VITRO*. Z.G. Jiang and C.N. Allen. Center for Research on Occupational and Environmental Toxicology and Department of Physiology, Oregon Health Sciences University.

205 EFFECTS OF A MELATONINERGIC ANTAGONIST S 20928 OR AN AGONIST S 20304 ON THE SEASONAL OBESITY PRESENTED BY THE GARDEN DORMOUSE. P. Delagrange[a], S. Le Gouic[b], P. Morgan[c], D. Sugden[d], P. Renard[a], D. Lesieur[e], L. Ambid[b], and B. Guardiola-Lemaître[a]. [a]IRIServier; [b]Lab. de Biologie des Tissus Adipeux; [c]Rowett Research Institute; [d]King's College; [e]Institut de Chimie Pharmaceutique.

206 THE ROLE OF PINEAL GLAND IN THE CIRCADIAN RHYTHM OF THE PAIN SENSITIVITY. Ma Kongchen, Li Jingcai, Wang Min, and Xu Feng. Department of Physiology, Shenyang College of Pharmacy.

207 EFFECT OF MELATONIN ON THE PHYSIOLOGICAL FUNCTIONS OF ANIMALS IN LIGHT-DARK REGIMES. Li Jingcai, Xu Feng, Yang Yingbao, Huang Fengyang, Xhang Qian, Liu Yonggang, and Cheng Wenyu. Chronobiological Lab, Shenyang College of Pharmacy.

208 CIRCADIAN EFFECTS OF MELATONIN ON IMMUNE FUNCTIONS IN MICE. Yang Yingbao, Li Jingcai , Wu Shuguang*, Xu Feng, and Huang Fengyang Chronobiological Laboratory, Shenyang College of Pharmacy; *Department of Pharmacology, The First Military Medical College.

209 EFFECT OF MELATONIN ON HYPOTHALAMIC AMINO ACID NEUROTRANSMITTERS. Xu Feng, Li Jingcai, Ma Kongcen, and Wang Min. Chronopharmacological Lab, Shenyang College of Pharmacy.